FORM PTO-1390 (Modified) (REV 11-2000) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER	U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR
Berge-2	filed herewith 09/937508

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/FR00/00751	24 March 2000	26 March 1999

TITLE OF INVENTION
DROP CENTERING DEVICE

APPLICANT(S) FOR DO/EO/US
BERGE, Bruno

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (24) indicated below.
4. ☒ The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
   a. ☐ is attached hereto (required only if not communicated by the International Bureau).
   b. ☒ has been communicated by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   a. ☒ is attached hereto.
   b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
   a. ☐ are attached hereto (required only if not communicated by the International Bureau).
   b. ☐ have been communicated by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☒ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
10. ☐ An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).
11. ☐ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☐ A copy of the International Search Report (PCT/ISA/210).

Items 13 to 20 below concern document(s) or information included:

13. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☐ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☐ A substitute specification.
18. ☐ A change of power of attorney and/or address letter.
19. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
20. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
21. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
22. ☒ Certificate of Mailing by Express Mail
23. ☒ Other items or information:

Copy of front page of PCT application as published, International Search Report, IDS references, PTO - form 1449 and acknowledgment postcard.

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR) filed herewith 09/937508	INTERNATIONAL APPLICATION NO. PCT/FR00/00751	ATTORNEY'S DOCKET NUMBER Berge-2

24. The following fees are submitted:.

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :

		CALCULATIONS PTO USE ONLY
☐	Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO	$1000.00
☒	International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO	$860.00
☐	International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO	$710.00
☐	International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4)	$690.00
☐	International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4)	$100.00

ENTER APPROPRIATE BASIC FEE AMOUNT =		$860.00
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).		$0.00

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	8 - 20 =	0	x $18.00	$0.00	
Independent claims	3 - 3 =	0	x $80.00	$0.00	
Multiple Dependent Claims **(check if applicable).**			☐	$0.00	

TOTAL OF ABOVE CALCULATIONS =		$860.00
☒ Applicant claims small entity status. (See 37 CFR 1.27). The fees indicated above are reduced by 1/2.		$430.00
SUBTOTAL =		$430.00
Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (f)). +		$0.00
TOTAL NATIONAL FEE =		$430.00
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) **(check if applicable).** ☐		$0.00
TOTAL FEES ENCLOSED =		$430.00
	Amount to be: refunded	$
	charged	$

a. ☒ A check in the amount of **$430.00** to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. _____ in the amount of _____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. **04-1679** A duplicate copy of this sheet is enclosed.

d. ☐ Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

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24,277
REGISTRATION NUMBER

September 25, 2001
DATE

DROP CENTERING DEVICE

The present invention relates to the maintaining of a liquid drop in a predetermined position on a solid surface, and more specifically to the centering of such a drop.

For various reasons, it may be desired to maintain a drop laid on a surface, accurately centered on a predetermined axis. A known way consists of modifying around this axis the surface wetability with respect to the drop liquid.

Fig. 1 shows a side cross-section view of a liquid drop 2 laid on a surface 4. Surface 4 has been processed in a circular area C1 centered on an axis O. The processing of area C1 is such that its wetability with respect to the liquid of drop 2 is strong. Thus, capillarity forces maintain drop 2 centered on axis O.

An improvement, not shown, of such a surface processing consists of creating around axis O several concentric circular areas. The processing of these areas then is such that the closer an area is to axis O, the more its wetability with respect to the liquid of drop 2 is strong. Such an improvement enables centering drop 2 for different contact angles. This is particularly advantageous when a way of changing said angle is available, for example by means of an electric voltage. Such surface processings may however be difficult and expensive to implement.

An object of the present invention is to center a drop laid on a surface without using a modification of the surface wetability.

To achieve this object, the present invention provides a method for centering a liquid drop at a given location of a surface, which consists of forming at this location a flared hollow such that, at any point of the contact limit between the drop and the hollow, said hollow has a curvature smaller than or opposite to that of a circle tangent to the hollow surface at said point and at a symmetrical point of this surface.

According to an embodiment of the present invention, the flared hollow has the shape of a truncated cone with an axis perpendicular to said surface.

According to an embodiment of the present invention, the flared hollow has the shape of the upper central portion of a torus having an axis perpendicular to the surface.

According to an embodiment of the present invention, a method for centering a liquid drop on the external surface of a convex surface is provided, which consists of giving this surface at any point of the contact limit with the drop a shape such that this surface has a curvature greater than that of a circle tangent to this surface at this point and at a symmetrical point of this surface.

According to an embodiment of the present invention, the convex surface is formed by revolution against said axis of an arc of a circle having a radius smaller than that of said tangent circle.

The present invention also provides a variable-focus lens implementing the above-mentioned method, which includes a wall made of an isolating material, a drop of a first isolating liquid arranged on an area of a first surface of the wall, a second conductive liquid covering the first surface and the drop, the first and second liquids being non-miscible, having different optical indexes and substantially the same density, and means for applying an electric voltage between the conductive liquid and an

electrode arranged on the second surface of said wall, the drop being placed in a flared hollow of the wall.

According to an embodiment of the present invention, the electrode is a sheet metal, the flared hollow is a truncated cone formed by embossing said sheet metal, centered on an axis perpendicular to the first surface, and the bottom of which is pierced with a centered hole, and the isolating material wall is a transparent plastic film flattened against the electrode and the walls of the hollow, and which covers said hole.

According to an embodiment of the present invention, the electrode is a sheet metal, the flared hollow is a truncated cone formed by machining said sheet metal, centered on an axis perpendicular to the first surface, and the bottom of which is pierced with a centered hole, and the isolating material wall is a transparent plastic film flattened against the electrode and the walls of the hollow, and which covers said hole.

The foregoing objects, features and advantages of the present invention, will be discussed in detail in the following non-limiting description of specific embodiments in connection with the accompanying drawings.

Fig. 1, previously described, shows a side cross-section view of a drop-centering means according to prior art;

Fig. 2 shows a side cross-section view of a liquid drop laid on a planar surface;

Figs. 3 to 7 are side cross-section views of a liquid drop placed in a flared hollow of a surface;

Figs. 8 to 10 are side cross-section views of a liquid drop located at one end of a drop-grasping rod;

Fig. 11 shows a side cross-section view of an application of the present invention to the centering of a transparent liquid drop used as a lens; and

Fig. 12 shows a side cross-section view of an alternative of Fig. 11.

Same elements have been designated with same references in the following drawings. In particular, reference 2 will desig-

nate a liquid drop of small dimensions, having its position on a surface essentially defined by the capillarity forces (the surface tension). Reference 4 will designate a surface, the wetability of which is constant with respect to the liquid of drop 2.

Fig. 2 shows a planar surface 4 cut by an axis O perpendicular to this surface. If a liquid drop is desired to be placed at a position A centered on axis O, for example, by being deposited from a drop-grasping rod, the chances of achieving this with precision are small, the drop remaining where it has been laid, for example, at a position B.

As illustrated in Fig. 3, to solve the problem of the centering of a drop 2 with respect to an axis O, the present inventor has first thought of placing drop 2 in a hollow formed in surface 4, this hollow having the shape of a spherical cap symmetrical with respect to axis O. However, any position of drop 2 in hollow 6 has appeared to be a stable position. Thus, as in the case of a planar surface 4, if drop 2 is desired to be placed at a position A centered on axis O, the chances of achieving this with precision are small since the drop will remain where it has been laid, for example, at a position B.

First, the present inventor has thus abandoned the idea of centering a drop by means of a hollow. Thus, French patent application number 97/12781 deposited by the present applicant describes a variable-focus liquid lens formed by a liquid drop laid at the surface of a solid, centered on an axis by the means described in relation with Fig. 1. This application further describes electromagnetic means for deforming the drop while maintaining it centered on the axis.

On the other hand, this patent application describes a variable-focus liquid lens formed by a liquid drop contained in a tube and maintained centered on the tube axis by capillarity. There thus appears that a drop 2 can be centered on an axis O by being placed in a cylindrical hollow of surface 4, centered on this axis. However, it is difficult to place a liquid drop in

such a cylindrical hollow while avoiding for a bubble to remain at the drop basis.

The present inventor has then systematically searched which type of hollow centered on an axis O enables easy centering of a liquid drop on this axis.

Figs. 4 to 7 each represent a side cross-section view of a liquid drop 2 placed in a flared hollow 6 centered on an axis O and formed in a surface 4. For a position A of drop 2, centered on axis O, CP1 designates any point of the contact limit between drop 2 and the surface of hollow 6. The circle having its center located on axis O, and which is tangent to the surface of the hollow both at point CP1 and at a symmetrical point CP2, is called the tangent circle TC.

Fig. 4 represents a liquid drop 2 placed in a hollow 6 formed by the revolution around axis O of an arc of a circle having a radius smaller than that of previous circle TC. Thus, at any point CP1 of the contact limit between the hollow surface and the drop, the surface curvature of the hollow is greater than that of circle TC.

Fig. 5 shows a liquid drop 2 placed in a hollow 6 formed by revolution of a segment around axis O. Hollow 6 is a truncated cone. Thus, at any point CP1 of the contact limit with the drop, the surface curvature of hollow 6 is null, smaller than that of tangent circle TC.

Fig. 6 shows a liquid drop 2 placed in a hollow 6 formed by revolution around axis O of an arc of a circle greater than that of previous circle TC. Thus, at any point CP1 of the contact limit with the drop, the surface curvature of the hollow is smaller than that of tangent circle TC.

Fig. 7 shows a liquid drop 2 placed in a hollow 6 formed by revolution around axis O of an arc of a circle having a curvature opposite to that of tangent circle TC. Hollow 6 corresponds to the central upper portion of a torus. At any point CP1 of the contact limit with the drop, the surface curvature of hollow 6 is opposite to that of tangent circle TC.

The present inventor has shown that, for a drop 2 placed in a flared hollow 6 centered on an axis O, the surface curvature of hollow 6 at any point CP1 of the contact limit with the drop determines whether a position A of the drop centered on axis O is a position of equilibrium or not.

Thus, when, as in Figs. 5, 6, and 7, the curvature at any point CP1 is smaller than or inverse to that of tangent circle TC, a drop placed in such a hollow naturally takes a position A centered on axis O.

On the other hand, when, as in Fig. 4, the curvature at any point CP1 is greater than that of tangent circle TC, a position A of the drop, centered on axis O, is particularly unstable and will not be able to be maintained. A drop placed in such a hollow naturally takes an out-of-center position B with respect to axis O.

Finally, when, as in Fig. 3, the curvature at any point CP1 is equal to that of tangent circle TC, any position of the drop is stable, and a drop placed in such a hollow at a position B brought out of center will keep this position.

Thus, the present invention provides a method for centering a drop at a given location of a surface consisting of forming at this location a flared hollow such that, at any point CP1 of the contact limit with the drop, this hollow has a curvature smaller than or opposite to that of tangent circle TC.

It should be noted that only the contact limit between the drop and the hollow surface counts. The shape of the hollow has no importance and it may be flat, convex, or concave.

According to another aspect of the present invention, a convex surface of uniform wetability centered on an axis O is considered, on which is laid a liquid drop, in a position A centered on axis O. The previously-described point CP1 and tangent circle TC are considered again.

Figs. 8 to 10 are side cross-section views of a liquid drop 14 placed on a convex surface 16 centered on an axis O.

Fig. 8 shows the case where the convex surface is spherical. The surface of sphere 16 at any point CP1 of the contact limit with drop 14 is always confounded with tangent circle TC.

In the case of Fig. 9, the convex surface is conical. The "curvature" of conical surface 16 at any point CP1 of the contact limit with drop 14 is always smaller than that of tangent circle TC.

In the case of Fig. 10, the convex surface is formed by revolution around axis O of an arc of a circle having a radius smaller than that of tangent circle TC. The surface curvature at any point CP1 of the contact limit with drop 14 is always greater than that of tangent circle TC.

The present inventor has shown that, for a drop 14 placed on a convex surface 16 centered on an axis O, the curvature at any point CP1 of the contact limit with the drop determines whether a position A of the drop, centered on axis O, is a position of equilibrium of not.

Thus, when, as in Fig. 10, the curvature at any point CP1 is greater than that of tangent circle TC, a drop placed on such a surface naturally takes a position A centered on axis O.

However, as in Fig. 9, the curvature at any point CP1 is smaller than that of tangent circle TC, a position A of the drop, centered on axis O, is unstable. A drop placed on such a surface naturally takes a position B brought out of center with respect to axis O.

Finally, when, as in Fig. 8, the curvature at any point CP1 is equal to that of tangent circle TC, any position of the drop is stable, and a drop placed at an out-of-center position B will keep this position.

Thus, the present invention provides a method for centering a drop on a convex surface which consists, at any point CP1 of the contact limit with the drop, of giving the surface a curvature greater than that of tangent circle TC.

According to an application of this method, convex surface 16 forms the end of a rod 18 for grasping a drop 14. Indeed, for certain chemical or biological handling operations, it is desirable to have drop-grasping rods which enable precisely and reliably handling liquid drops. A drop-grasping rod, the end of which is formed according to the present invention, enables conveying definitely centered drops.

An application of the present invention to the forming of a means for centering a liquid drop used as an optical lens will now be described.

Fig. 11 shows a simplified cross-section view of such a variable-focus liquid lens, formed in a dielectric enclosure 4 filled with a conductive liquid 8. Dielectric 4 naturally has a low wetability with respect to conductive liquid 8. A lower surface of a wall of enclosure 4 includes a hollow 6, centered around an axis O perpendicular to this wall. Hollow 6 is a truncated cone according to the present invention, such as that shown in Fig. 5. A drop of an isolating liquid 2 is placed in hollow 6. As seen previously, isolating liquid drop 2 naturally takes a position A centered on axis O. Isolating liquid 2 and conductive liquid 8 are both transparent, non-miscible, they have different optical indexes and have substantially the same density. The dioptre formed between liquids 8 and 2 forms a surface of a liquid lens, the optical axis of which is axis O and the other surface of which corresponds to the contact between the drop and the bottom of the hollow. An electrode 10, including a hole 11 in the vicinity of axis O, is placed on the external surface of dielectric enclosure 4. An electrode 12 is in contact with conductive liquid 8. Electrode 12 may be immersed in liquid 8, or be a conductive deposition performed on an internal wall of enclosure 4. A voltage source (not shown) enables applying a voltage V between electrodes 10 and 12.

Voltage V may be increased from 0 volt to a maximum voltage, which depends on the used materials. When the voltage increases, isolating liquid drop 2 deforms to reach a limiting

position (designated with reference B). While drop 2 deforms from its position A to its position B, the focus of the liquid lens varies.

It should be noted that, drop 2 being an isolating liquid, no microdrops occur at its periphery when voltage V is high, conversely to what would occur if the drop was a conductive liquid.

The conical shape of hollow 6 is such that, whatever the shape of drop 2 that it contains, the curvature of its surface at any contact point between the limit of the drop and the surface is smaller than that of a tangent circle TC crossing this point. Thus, according to an aspect of the present invention, hollow 6 is such that, all along its deformation from its position A to its position B, liquid drop 2 is continuously maintained centered on axis O. A liquid lens with a accurately fixed optical axis and with a focus varying with voltage V is thus available.

It should be noted that a hollow 6 according to the present invention, which ensures the continuous centering of liquid drop 2, is relatively simple to implement and that it advantageously replaces the electromagnetic centering means or the surface processing centering means described in above-mentioned French patent application.

An A.C. voltage will preferably be used for voltage V, to avoid the accumulation of electric loads across the thickness of material 4, from the surface on which is laid drop 2.

As an example, water charged with salts (mineral or others) or any liquid, organic or not, which is conductive or made such by addition of ionic components may be used as a conductive liquid 8. For isolating liquid 2, oil, an alkane or a mixture of alkanes, possibly halogenated, or any other isolating liquid non miscible with conductive liquid 8 may be used. Dielectric wall 4 may be a glass plate or a superposition of fluorinated polymer, epoxy resin, polyethylene. Electrode 10 may be a metal deposition.

Fig. 12 shows a simplified cross-section view of an alternative embodiment of the variable-focus liquid lens of Fig. 11. Same references designate same elements in Figs. 11 and 12. In this embodiment, electrode 10 may be a metal sheet in which hollow 6 is formed by embossing. It may also be a metal wall in which hollow 6 has been formed by machining, then polishing. Wall 4 then is, for example, a thin transparent plastic film flattened against electrode 10 and which covers hole 11. This plastic film may for example be flattened by thermoforming.

In the example of application of Fig. 12, drop 2 has an idle diameter of approximately 1 to 5 mm. Conductive liquid 8 and the isolating liquid of drop 2 being substantially of same density, drop 2 has the shape of a spherical cap. When idle (position A), the edge of drop 2 makes an angle of approximately 45 degrees with the surface of hollow 6, if the latter is a cone having a 45-degree slope. In its limiting position (position B), the edge of drop 2 makes an angle of approximately 90 degrees with the surface of enclosure 4. The described device, using as a conductive liquid 8 salt water having an optical index 1.35 and, as the isolating liquid of drop 2, oil with optical index 1.45, enables obtaining approximately 30 diopters of focus variation for an applied voltage of 250 V and a dissipated electric power of a few mW. The frequency of the A.C. voltage ranges in this case between 100 and 10,000 Hz, its period being much smaller than the system response time of approximately a few hundredths of a second.

The variable-focus lens according to the present invention may have a size ranging between a few hundreds of μm and a few tens of mm and may in particular be applied to the field of optoelectronic, endoscopy, imaging and vision systems.

Of course, the present invention is likely to have various alternatives and modifications which will occur to those skilled in the art. In particular, the present description has been made in relation with hollows having a circular cross-section, that is, formed by rotation around an axis O. However,

elongated hollows having the shape of a channel may for example be provided. In this case, Figs. 5 to 7 will be considered as describing the cross-section view of a channel, and axis O will represent the symmetry plane of said channel.

On the other hand, a hollow 6 with a flat bottom has been shown in Fig. 11, which results in a plano-convex lens. Now, it has been seen that the shape of the bottom of hollow 6 does not influence its properties of centering of drop 2. Thus, bi-convex or meniscus lenses may easily be formed by modifying the curvature of the bottom of hollow 6.

On the other hand, also, an embodiment of a variable-focus lens using a conical hollow such as in Fig. 5 has been shown in Figs. 11 and 12, but the present invention will easily be adapted to a variable-focus lens using another shape of hollow according to the present invention.

Finally, a device including a network formed of groups of three separately-controlled variable-focus lenses, red-, green- and blue-colored, operating for example in all or nothing, enabling letting through or stopping the light coming from a single white light source may be formed, thus forming an illuminated color screen that can be very large and of low cost.

CLAIMS

1. A method for centering a liquid drop (2) at a given location of a surface (4), characterized in that it consists of forming at this location a flared hollow (6) such that, at any point (CP1) of the contact limit between the drop and the hollow, said hollow has a curvature smaller than or opposite to that of a circle (TC) tangent to the hollow surface at said point and at a symmetrical point (CP2) of this surface.

2. The method of claim 1, characterized in that the flared hollow (6) has the shape of a truncated cone with an axis perpendicular to said surface.

3. The method of claim 1, characterized in that the flared hollow (6) has the shape of the upper central portion of a torus having an axis perpendicular to the surface.

4. A method for centering a liquid drop (14) on the external surface of a convex surface (16), characterized in that it consists of giving this surface at any point (CP1) of the contact limit with the drop a shape such that this surface has a curvature greater than that of a circle (TC) tangent to this surface at this point and at a symmetrical point (CP2) of this surface.

5. The method of claim 4, characterized in that it consists of forming the convex surface (6) by revolution against said axis of an arc of a circle having a radius smaller than that of said tangent circle.

6. A variable-focus lens, including:

a wall made of an isolating material (4),

a drop of a first isolating liquid (2) arranged on an area of a first surface of the wall,

a second conductive liquid (8) covering the first surface and the drop, the first and second liquids being non-miscible, having different optical indexes and substantially the same density, and

means (12) for applying an electric voltage (V) between the conductive liquid and an electrode (10) arranged on the second surface of said wall,

characterized in that the drop is placed in a flared hollow (6) of the wall according to the method of claim 1.

7. The variable-focus lens of claim 6, characterized in that:

the electrode (10) is a sheet metal,

the flared hollow (6) is a truncated cone formed by embossing said sheet metal, centered on an axis (O) perpendicular to the first surface, and the bottom of which is pierced with a centered hole (11), and

the isolating material wall (4) is a transparent plastic film flattened against the electrode and the walls of the hollow, and which covers said hole.

8. The variable-focus lens of claim 6, characterized in that:

the electrode (10) is a sheet metal,

the flared hollow (6) is a truncated cone formed by machining said sheet metal, centered on an axis (O) perpendicular to the first surface, and the bottom of which is pierced with a centered hole (11), and

the isolating material wall (4) is a transparent plastic film flattened against the electrode and the walls of the hollow, and which covers said hole.

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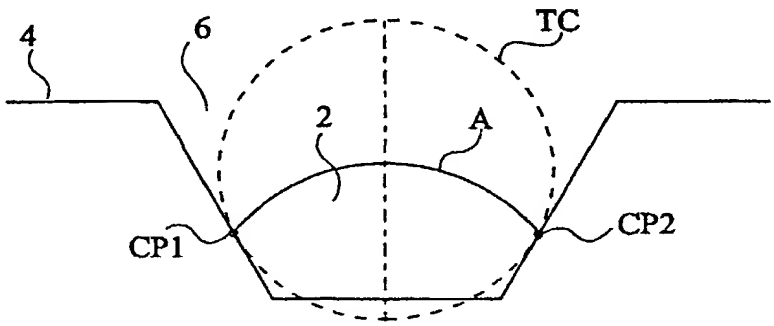
(54) Title: DROP CENTERING DEVICE

(54) Titre: DISPOSITIF DE CENTRAGE D'UNE GOUTTE

(57) Abstract

A method for centering a drop of liquid (2) on a given point on a surface (4). The inventive method consists in forming a bell–mouthed recess (6), whereby said recess has a curvature at any point at the limit of contact between the drop and the recess that is lower than or opposite to the curvature of a circle (TC) that is tangent to the surface of the recess to said point and at a symmetrical point (CP2) of said surface.



(57) Abrégé

Procédé de centrage d'une goutte de liquide (2) à un emplacement donné d'une surface (4), qui consiste à former à cet emplacement un évidement évasé (6) tel que, en tout point (CP1) de la limite de contact entre la goutte et l'évidement, celui–ci à une courbure inférieure ou opposée à celle d'un cercle (TC) tangent à la surface de l'évidement audit point et en un point symétrique (CP2) de cette surface.

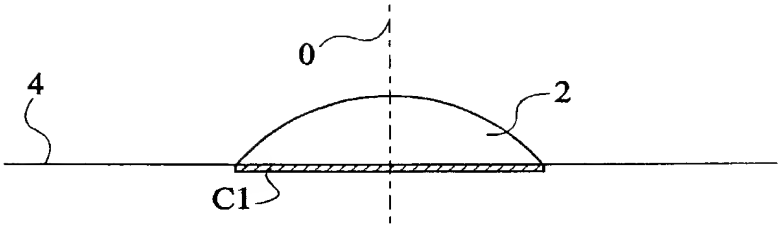


Fig 1

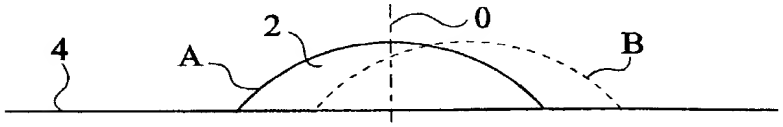


Fig 2

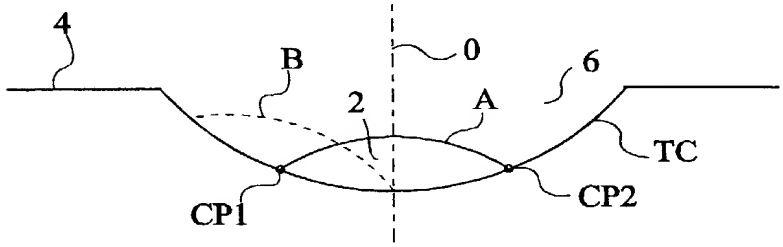


Fig 3

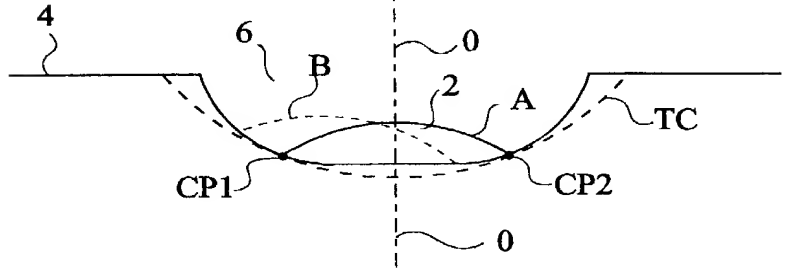


Fig 4

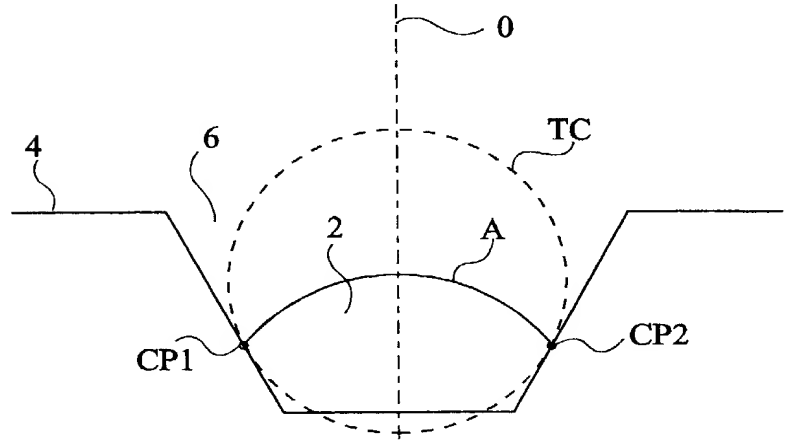


Fig 5

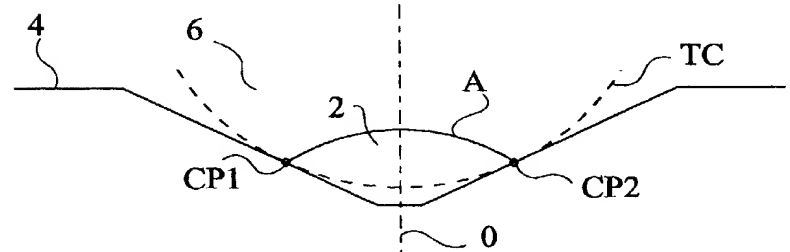


Fig 6

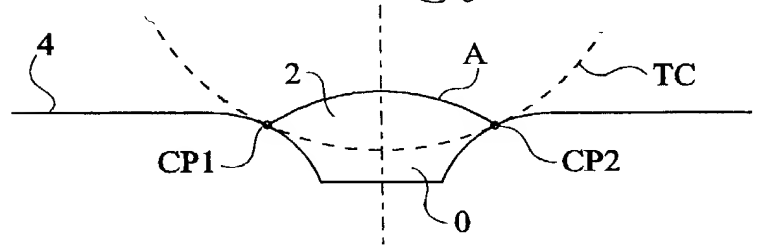


Fig 7

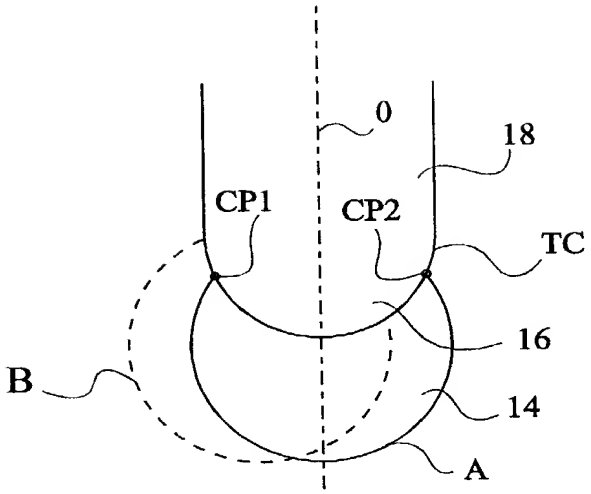


Fig 8

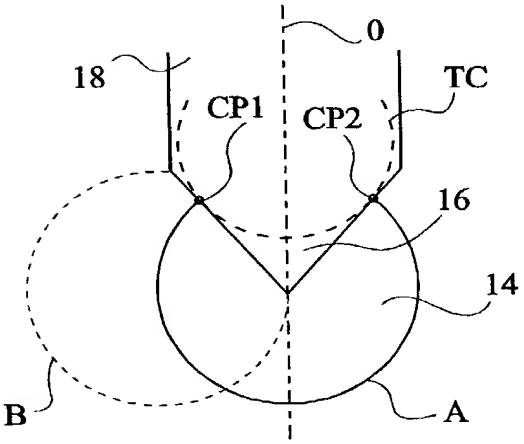


Fig 9

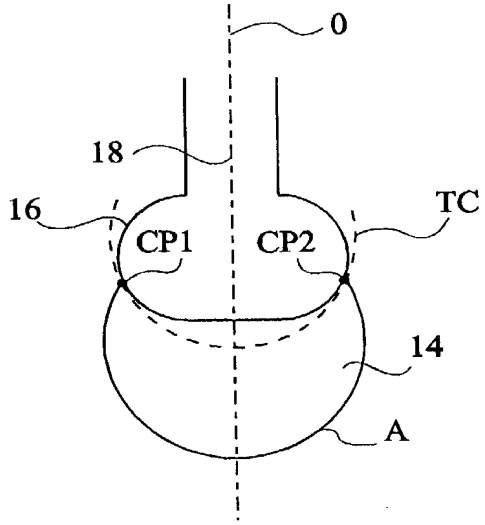


Fig 10

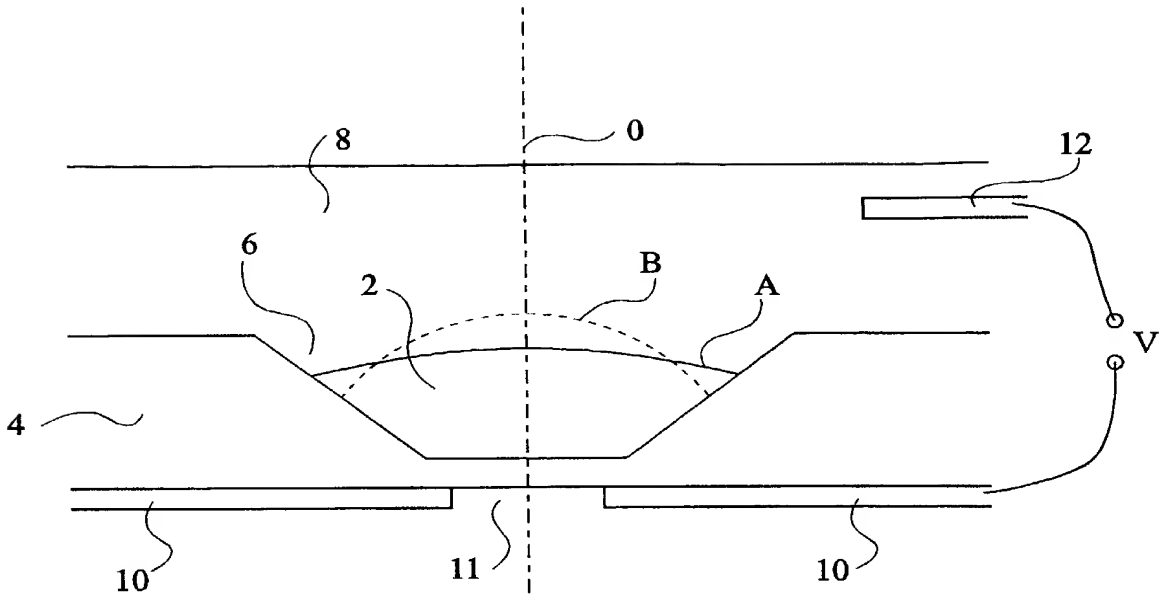


Fig 11

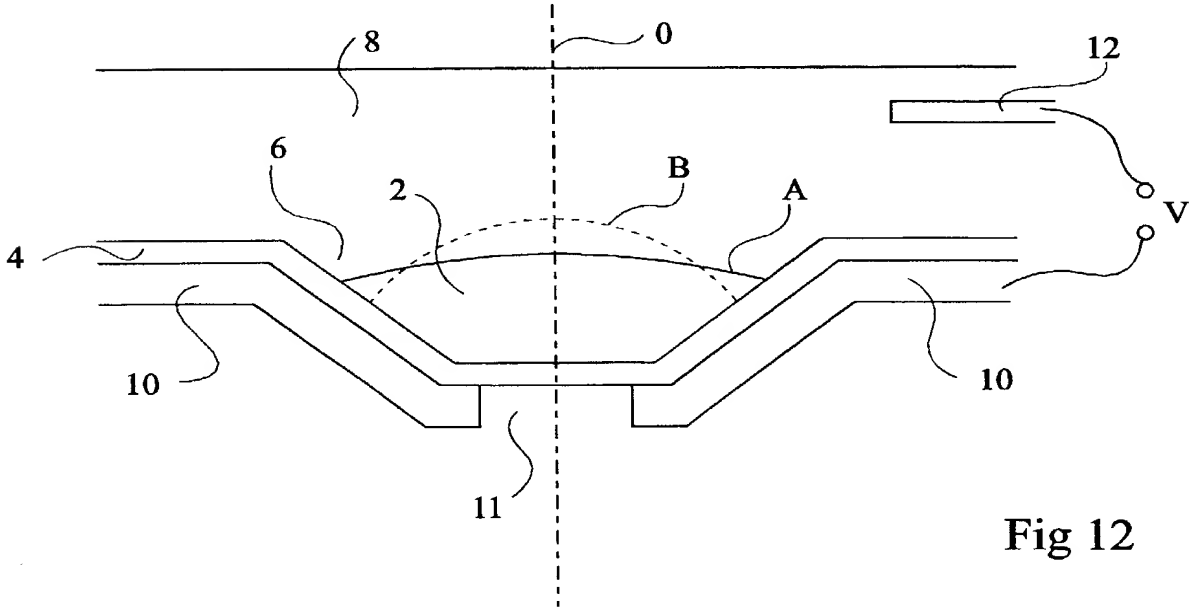


Fig 12

Docket No.
Berge-2

Declaration and Power of Attorney For Patent Application

English Language Declaration

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

DROP CENTERING DEVICE

the specification of which
(check one)

☐ is attached hereto.

☒ was filed on 25 SEPTEMBER 2001 as United States Application No. or PCT International Application Number 09/937 508

and was amended on _____ (if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d) or Section 365(b) of any foreign application(s) for patent or inventor's certificate, or Section 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate or PCT International application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)			Priority Not Claimed
PCT/FR00/00751	PCT	24 MARCH 2000	☐
(Number)	(Country)	(Day/Month/Year Filed)	
99/03980	FRANCE	26 MARCH 1999	☐
(Number)	(Country)	(Day/Month/Year Filed)	
			☐
(Number)	(Country)	(Day/Month/Year Filed)	

I hereby claim the benefit under 35 U.S.C. Section 119(e) of any United States provisional application(s) listed below:

(Application Serial No.)	(Filing Date)
(Application Serial No.)	(Filing Date)
(Application Serial No.)	(Filing Date)

I hereby claim the benefit under 35 U. S. C. Section 120 of any United States application(s), or Section 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. Section 112, I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, C. F. R., Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application:

(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)
(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)
(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. *(list name and registration number)*

Any attorney associated with Customer No. 28581

28581
PATENT TRADEMARK OFFICE

Send Correspondence to: The address associated with Customer No. 28581

Direct Telephone Calls to: *(name and telephone number)*
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1-00

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Citizenship
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